CLAIMS

What is claimed is:

1. A method for enabling synchronization of a communications terminal in a wireless communication system comprising:

receiving a burst at a receiver of the communications terminal, the burst containing a composite waveform including two or more component waveforms, wherein each of the two or more waveforms has a known frequency variation throughout the burst.

2. The method of Claim 1 further comprising detecting a first component waveform of said two or more component waveforms.

3. The method of Claim 2 further comprising detecting a second component waveform of said two or more waveforms.

4. The method of Claim 3 further comprising estimating, after both of said detecting steps, a frequency offset and a timing offset of said composite waveform as received into said receiver.

5. The method of Claim 3 wherein said detecting said first component waveform comprises desweeping said first component waveform into a first deswept component waveform, wherein said first deswept component waveform is a narrow band waveform.

6. The method of Claim 5 further comprising transforming said first deswept component waveform into a first frequency domain representation.

7. The method of Claim 6 wherein said transforming includes using a Fast Fourier Transform.

8. The method of Claim 6 further comprising estimating a signal-to-noise ratio of said first frequency domain representation.

9. The method of Claim 8 further comprising comparing said signal-to-noise ratio of said first frequency domain representation to a threshold.

10. The method of Claim 9 further comprising estimating, in the event said threshold is exceeded, a first peak frequency of said first frequency domain representation.

11. The method of Claim 10 further comprising using a Discrete Fourier Transform to fine-tune the estimate of said first peak frequency.

12. The method of Claim 10 further comprising:

desweeping said second component waveform of said two or more component waveforms into a second deswept component waveform; and

transforming said second deswept component waveform into a second frequency domain representation.

13. The method of Claim 12 further comprising estimating a second peak frequency from said second frequency domain representation.

14. The method of Claim 13 further comprising estimating a frequency offset and a timing offset of said composite waveform as received into said receiver, whereby synchronization is achieved.

15. The method of Claim 13 wherein said estimating comprises estimating, using said first peak frequency and said second peak frequency and said known frequency variation of each of said first component waveform and said second component waveform.

16. The method of Claim 15 wherein said frequency offset is defined by the formula:

$$f_d = 0.5(f_1 + f_2)$$

wherein f_d is said frequency offset in Hertz, f_1 is said first peak frequency in Hertz, and f_2 is said second peak frequency in Hertz.

17. The method of Claim 15 wherein said timing offset is defined by the formula:

$$t_0 = \tau-[(f_1 - f_2)/2K]$$

wherein f_1 is said first peak frequency in Hertz, f_2 is said second peak frequency in Hertz, K is the absolute value of said known frequency variation of said each of said first component waveform and said second component waveform in Hertz/second, and τ is a time in seconds at which said composite waveform is hypothesized to arrive at said communications terminal.

18. The method of Claim 1 wherein said receiving comprises receiving said burst through a channel, wherein said composite waveform has a composite bandwidth on an order of an available channel bandwidth, wherein each of said two or more component waveforms has a component bandwidth on the order of the available channel bandwidth.

19. The method of Claim 18 wherein said receiving further comprises said receiving, wherein a range of values for the differences between the instantaneous frequencies of two of said two or more

component waveforms is on an order of twice of said available channel bandwidth.

20. The method of Claim 1 wherein said composite waveform comprises a dual-chirp waveform including an up-chirp waveform and a down-chirp waveform.

21. An acquisition system of a wireless communications terminal for acquiring a received composite waveform including two or more component waveforms and estimating a frequency offset and a timing offset of the received composite waveform comprising:

a first phase shifter for desweeping a first component waveform of the received composite waveform; and

a first processor coupled to the first phase shifter for transforming the first component waveform having been deswept into a first frequency domain representation.

22. The system of Claim 21 wherein said first processor is a first fast Fourier transform processor.

23. The system of Claim 21 further comprising a detection processor coupled to said first processor for detecting a peak of said first frequency domain representation, whereby detecting the presence of said first component waveform.

24. The system of Claim 23 wherein said detection processor estimates a first peak frequency of said first frequency domain representation.

25. The system of Claim 24 wherein said detection processor includes a discrete Fourier transform

for fine-tuning the estimation of said first peak frequency.

26. The system of Claim 23 further comprising:

a second phase shifter for desweeping a second component waveform of said received composite waveform; and

a second processor coupled to the second phase shifter for transforming the second component waveform, having been deswept, into a second frequency domain representation.

27. The system of Claim 26 wherein said second processor is a second fast Fourier transform processor.

28. The system of Claim 26 further comprising a detection processor coupled to said second processor for detecting a peak of said second frequency domain representation.

29. The system of Claim 28 wherein said detection processor estimates a second peak frequency of said second frequency domain waveform.

30. The system of Claim 29 wherein said detection processor includes a discrete Fourier transform for fine-tuning the estimation of said second peak frequency.

31. The system of Claim 29 wherein said detection processor includes a parameter estimator for computing said frequency offset and said timing offset of said received composite waveform.

32. The system of Claim 21 wherein said received composite waveform comprises a received dual-chirp waveform.

33. The system of Claim 21 further comprising:

a matched filter for filtering the received composite waveform; and

a buffer coupled to the matched filter, wherein the buffer is further coupled to said first phase shifter.

34. A method for enabling synchronization of a communications terminal in a wireless communication system comprising:

receiving a burst at a receiver of the communications terminal, the burst containing a composite waveform including two or more component waveforms, wherein each of the two or more waveforms has a known frequency variation throughout the burst;

detecting the presence of the composite waveform; and

estimating a frequency offset and a timing offset of the composite waveform as received into said receiver, whereby synchronization is achieved.

35. The method of Claim 34 wherein said detecting comprises detecting a first component waveform of said two or more component waveforms.

36. The method of Claim 35 wherein said detecting said first component waveform comprises:

desweeping said first component waveform into a first deswept component waveform;

transforming the first deswept component waveform into a first frequency domain representation; and

determining if the signal to noise ratio of the first frequency domain representation exceeds a threshold.

37. The method of Claim 36 wherein said estimating comprises:

estimating a first peak frequency of said first frequency domain representation;

desweeping said second component waveform into a second deswept component waveform;

transforming the second deswept component waveform into a second frequency domain representation;

estimating a second peak frequency of the second frequency domain representation;

estimating said frequency offset and said timing offset using the first peak frequency and the second peak frequency and said known frequency variation of each of said first component waveform and said second component waveform.